

Meteorological conditions during solar observations, Blue Hill, Mass.

Date	Time from local noon	Temperature °C.	Wind Beaufort	Visi-bility	Blue sky	Cloudiness and remarks
Apr. 1	4.20 a. m.	0.3	WNW 3	7	7	Few Ci; moderate haze.
1	2.17 a. m.	3.3	NNW 3	9	8	Few Ci; light haze.
1	0.16 p. m.	7.3	NW 3	9	8	Few Ci; few Cu.
1	2.34 p. m.	8.6	W 3	9	8	2 Cu; light haze.
1	4.52 p. m.	8.8	NW 3	9	8	Trace Ci; trace Cu; light haze.
4	4.17 a. m.	1.7	NW 2	6	7	3 Ci; few Acu; few Cu; moderate, dense haze.
7	4.34 p. m.	9.4	NW 3	8	7	2 Ci; light haze.
11	3.18 a. m.	1.8	NW 3	9	7	1 Acu; few Scu; light haze to north.
11*	3.08 a. m.	3.1	NW 3	9	7	1 Acu; 1 Cu; scu, light haze to north, instrument indoors.
12	3.27 a. m.	4.5	NW 3	8	8	1 Acu; few Cu; moderate haze to north.
12	0.24 a. m.	7.8	NNW 3	8	8	6 Cu; light haze to north, west, and south.
12	2.35 p. m.	7.9	NE 2	9	8	9 scu; light haze to north.
13	0.06 p. m.	13.3	WSW 3	9	8	2 Ci; light haze.
14	3.23 a. m.	10.1	S 3	7	8	2 Ci; moderate haze.
17	3.33 a. m.	4.0	NNE 4	9	7	Zero clouds, light haze.
17*	1.22 a. m.	4.7	NNE 5	9	7	Do.
17	1.03 a. m.	4.3	NNE 5	9	7	1 Ci; trace Acu; light haze.
19	3.27 a. m.	10.0	NW 5	7	7	Zero clouds, moderate water haze.
19	0.16 a. m.	13.1	NW 3	8	7	4 Cu; moderate water haze.
19	1.57 p. m.	15.8	NW 2	8	7	1 Cu; moderate haze.
20	3.16 a. m.	9.6	NW 5	9	7	Trace Cu; light haze.
20	1.34 a. m.	11.6	WNW 5	9+	7	1 Cu.
20	2.31 p. m.	14.0	W 6	9+	7	2 Cu.
24	3.41 a. m.	2.9	NNE 5	8	8	Zero clouds moderate haze to north and west.
24*	1.48 a. m.	3.9	NNE 4	8	8	Trace Cu; light haze.
24	1.07 a. m.	3.4	NNE 4	9	8	Trace Cu.
24	3.05 p. m.	4.8	NNE 4	9	8	1 Ci.
25	4.58 a. m.	2.8	NW 3	8	8	3 Ci.
25	0.02 a. m.	9.6	NNE 3	9	8	Trace Ci; moderate haze to north and west.
26	3.56 a. m.	8.5	E 3	8	8	1 Ci; moderate haze to north and west.
26	0.08 p. m.	9.6	NE 4	9	8	2 Ci; light haze.
26	2.55 p. m.	7.7	NE 5	9	8	Zero clouds, light haze.
30	4.28 a. m.	5.9	NNE 5	8	8	Light haze.
30	1.11 a. m.	8.3	NNE 3	9	7	Do.
30	1.43 p. m.	9.5	NNE 4	9	7	Light haze to north.
30	4.37 p. m.	10.6	NE 3	10	7	

POSITIONS AND AREAS OF SUN SPOTS

NOTE.—The data for April 1937 will be published in the next issue of the Review.—Editor.

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR APRIL 1937

[Dependent alone on observations at Zurich and its station at Arosa]

[Furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich, Switzerland]

April 1937	Relative numbers	April 1937	Relative numbers	April 1937	Relative numbers
1-----	Mc 140	11-----	Ec 82	21-----	a 127
2-----	128	12-----	62	22-----	Mbbc —
3-----	d 112	13-----	38	23-----	b 144
4-----	Ec 139	14-----	—	24-----	Mbc 157
5-----	Ec 149	15-----	Eacd —	25-----	MEacd 190
6-----	114	16-----	64	26-----	157
7-----	Mc 121	17-----	a 63	27-----	161
8-----	96	18-----	Ec 76	28-----	149
9-----	ab 86	19-----	Ec 94	29-----	bd 123
10-----	71	20-----	Ec 127	30-----	b 94

Mean, 27 days = 113.5.

a = Passage of an average-sized group through the central meridian.

b = Passage of a large group or spot through the central meridian.

c = New formation of a group developing into a middle-sized or large center of activity: E, on the eastern part of the sun's disk; W, on the western part; M, in the central circle zone.

d = Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE, in charge]

By L. P. HARRISON

Mean free-air data based on airplane weather observations during the month of April 1937 are given in tables 1 to 3. A description of the methods by which the various monthly means and normals herein are computed may be found in this section of the MONTHLY WEATHER REVIEW of January and March 1937.

It will be noted that many of the "normals" are based on only 3 years of observations. Conclusions based on departures from such short-period "normals" must be used with caution.

The mean surface and free-air temperatures for April (see chart I and table 1) were practically normal over the entire country. Departures from normal were generally within the limits $\pm 1^\circ \text{C}$. At a few isolated stations, however, limits of $\pm 2^\circ \text{C}$. were reached.

The mean free-air relative humidities and specific humidities are given in table 2. Generally speaking, with the exclusion of the surface layer, several hundred meters in height, the mean relative humidities were slightly below normal in the southern half of the country (south of lat. 40°), except along the Pacific coast where they were mostly in excess of normal, and slightly above normal in the northern half of the country, except near Billings, where the opposite condition prevailed. The most pronounced negative departures from normal occurred over the vicinity of Pensacola, Fla., from 2.5 to 5 km above sea level, where they were -14 to -18 percent. By comparison of the data for El Paso, Tex.,

with those for surrounding stations, it may be inferred that similar departures occurred at that place, at least in the lower few kilometer above the surface. Elsewhere the negative departures were generally confined to the limits of -2 to -6 percent, but with values from -7 to -9 percent over Maxwell Field (Montgomery), Ala., through the stratum 1.5 to 3 km. The most pronounced positive departures from normal occurred over the vicinity of Spokane, Wash., from 3 to 5 km above sea level, with values from $+9$ to $+14$ percent. Departures from $+9$ to $+12$ percent occurred over Omaha, Nebr., up to 1.5 km above sea level, while similar departures occurred over Lakehurst, N. J., from 4 to 5 km. Elsewhere, the departures were largely within the limits $+2$ to $+7$ percent.

Table 3 shows the monthly mean free-air barometric pressures and equivalent potential temperatures. The lowest mean barometric pressures in the free-air up to 5 km prevailed over the north-central part of the country with minima in the vicinity of Sault Ste. Marie, Mich., and Fargo, N. Dak., at moderate and high elevations, and at Omaha, Nebr., up to about 1.5 km above sea level. A trough of low mean pressure thus apparently occurred over the northern and central portions of the Western Plains States with greatest intensity in the lower strata while similar troughs of appreciably less intensity occurred over the Ohio River Basin just west of the Appalachians and over the extreme northeastern part of the country. The

highest mean barometric pressures in the free air occurred over the coastal strip adjacent to the Gulf of Mexico, most pronounced, however, in the lower levels over Miami, Fla., and Pensacola, Fla., and in the upper levels over Miami and San Antonio, Tex. There was evidence of a weak wedge of mean high pressure extending from south to north over the Western Plateau region at moderate and higher elevations.

The mean isobaric charts for April indicate cyclonic curvature over the north-central portion of the country, and anticyclonic curvature over the southeastern and southwestern portions, especially marked in the lower few kilometers above the ground. The prevailing conditions were thus conducive to the transport of warm, moist air in the lower levels from the Gulf of Mexico over the extreme eastern portion of the country, and colder, less moist air from the northwest over the north-central portion.

On the assumption that the differences between the mean monthly barometric pressures given for the various pairs of stations are representative of the mean pressure gradients between the same pairs of stations during the month, the mean pressures afford evidence that the mean gradients from Pensacola, Fla., to Fargo, N. Dak., have increased 75 percent at 1 km and 10 percent at 2.5 km with respect to the gradients for the preceding month, while from Pensacola to Sault Ste. Marie, Mich., they have decreased about 30 percent at all levels up to 5 km. This is explained by the deepening of the statistical low pressure system over Fargo, the filling of the system over Sault Ste. Marie, and the constancy of the high pressure over Pensacola. At 0.5 and 1 km, the mean gradients between Oakland, Calif., and Fargo, reversed direction from March to April, with higher pressure resulting over the former place, and the Oakland to Fargo gradients at 1.5 to 2.5 km increased 300 to 100 percent, respectively, but at elevations 3 to 5 km only 38 to 0 percent. However, the mean gradients between San Antonio, Tex., and Oakland decreased 80 to 30 percent at the elevations from 1 to 3 km, respectively.

Table 4 shows the free-air resultant winds based on pilot-balloon observations made near 5 a. m. (75th meridian time) during April. Generally speaking, the resultant winds were largely normal in direction and mostly above normal in velocity by slight amounts (3 m. p. s.), with minor exceptions. Over Pensacola at 0.5 and 1 km, the resultant winds were oriented from 135° to 50° clockwise from normal, and velocity departures of +1.8 and +3.2 m. p. s., i. e. with stronger westerly components than usual. Over Sault Ste. Marie, clockwise orientations with respect to normal also prevailed, with departures ranging from 50° at the surface, 40° at 0.5 km, 150° at 1 and 1.5 km, and 15° to 50° from 2 to 3 km, hence up to 1.5 km, easterly components predominated by replacing the usual northerly components. The resultant wind velocities were mostly 3 to 4 m. p. s. in excess of normal over Seattle, Wash., up to 2.5 km. Similar or slightly larger departures occurred over Medford, Oreg., and Oakland, Calif., at 4 km. Departures of opposite sign were most common over the northeastern portion of the country, with departures from -2 to -4 m. p. s. over Boston, Mass., up to 3 km, and smaller departures at neighboring places.

Table 5 shows maximum free-air wind velocities and directions for various sections of the United States during April as determined by pilot balloon observations. The

extreme was 51.3 m. p. s. from the southwest at 2,290 meters above sea level over Winslow, Ariz.

The mean monthly equivalent potential temperatures and specific humidities are shown in tables 2 and 3, respectively. Charts of the latter element indicate notable deficiencies of moisture content over El Paso, Tex., with respect to surrounding stations, and slight excesses over Salt Lake City, Utah.

While the temperature conditions during April did not depart greatly from normal as already pointed out, marked contrast in the relative amount of precipitation compared to normal occurred in different sections of the country. A considerable number of anticyclones associated with shallow P_c and N_{pc} air masses moved down over the northwestern and north-central parts of the country from Canada during the month. These advanced southward, southeastward, eastward, and northeastward in a trajectory which frequently included the Great Plains and the Mississippi Valley. Thus shallow N_{pc} overlain by N_{pp} and P_r air masses not infrequently moved down over the Gulf States and the Gulf of Mexico. The relatively warm, moist conditions in these regions quickly transformed them into shallow T_A air masses.

At the same time, a number of anticyclones associated with P_r and N_{pp} air masses from the Pacific crossed the western coast of the country, as did a smaller number of cyclones, mostly from the region of the Aleutian Islands, hence in more northerly latitudes as a rule. These disturbances were effective in bringing about the transport of N_{pp} and T_r air into the warm sectors of the cyclones during their passage over the northwest coastal region, thus contributing to the copious precipitation 150 to 300 percent of normal which occurred in that area.

The P_r and N_{pp} air masses on crossing the west coast were frequently characterized by marked subsidence in the upper layers especially after passing the central portion of the Western Plateau. This produced exceedingly low relative humidities on many occasions over the entire Southwest, and some of the central part of the country where precipitation throughout a considerable area during April was only from 0 to 50 percent of normal.

An appreciable number of small cyclones, in some cases along old occluded fronts, developed along the fronts of the P_r and N_{pp} air masses when advancing across the relatively warm sections of the extreme Southwest. Owing to the great dryness in this region, precipitation was scanty from this source, but when the air masses in question reached the P_c and N_{pc} air masses along the eastern flanks of the Plateau, more well-defined warm sectors formed in the eastward progressing cyclones and the precipitation was not so meager. Further movement of these disturbances toward the Gulf States caused the N_{pp} air in the warm sectors to be replaced by the much warmer, and more moist T_A air masses from that neighborhood with the consequences that the cyclones became more energetic and precipitation more plentiful. Frequently aided by the circulation from the Gulf of Mexico during the occurrence of some well-marked transient anticyclone off the South Atlantic seaboard, the supply of moisture transported across the Gulf States northeastward up the Mississippi Valley east of the river was quite considerable and with the rapid development of the cyclones, precipitation over much of the area just specified generally reached amounts which totaled from 150 to 200 percent of normal during the month, with minor exceptions.

TABLE 1.—Mean free-air temperatures (t), °C. obtained by airplanes during April 1937. (Dep. represents departure from "normal" temperature)

Station	Altitude (meters) m. s. l																		
	Surface			500		1,000		1,500		2,000		2,500		3,000		4,000		5,000	
	Num- ber of obs.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.
Barksdale Field ¹ (Shreveport), La. (52 m)	29	14.3	-----	14.2	-----	13.0	-----	11.6	-----	9.0	-----	6.7	-----	4.0	-----	-2.5	-----	-----	-----
Billings, Mont. ¹ (1,089 m)	30	4.3	+2.0	-----	-----	-----	-----	5.8	+1.8	3.1	+1.4	-0.5	+1.0	-4.3	+0.7	-11.5	+0.3	-18.1	+0.2
Boston, Mass. ¹ (5 m)	25	5.3	-1.2	4.3	+0.1	2.1	-0.1	0.0	-0.4	-1.3	+0.3	-3.5	+0.3	-5.7	+0.3	-11.0	-0.1	-----	-----
Cheyenne, Wyo. ¹ (1,873 m)	30	0.7	-0.1	-----	-----	-----	-----	1.7	0.0	0.0	-----	-0.5	-0.9	-3.5	-0.8	-10.8	-1.2	-18.3	-1.3
Coco Solo, Canal Zone ¹ (15 m)	30	25.8	-----	23.6	-----	21.2	-----	19.0	-----	17.0	-----	15.3	-----	13.0	-----	7.4	-----	2.0	-----
El Paso, Tex. ¹ (1,194 m)	30	12.8	-----	-----	-----	-----	-----	15.8	-----	12.9	-----	9.3	-----	5.4	-----	-1.3	-----	-8.0	-----
Fargo, N. Dak. ¹ (274 m)	28	3.0	+2.3	3.7	+2.1	1.9	+1.7	-0.7	+1.2	-3.0	+1.0	-5.6	+0.7	-8.2	+0.6	-12.8	+0.9	-19.0	+0.7
Kelly Field (San Antonio), Tex. ¹ (206 m)	26	14.0	-1.2	16.3	-0.2	15.8	0.0	14.6	-0.1	13.2	+0.2	10.7	+0.2	8.0	+0.7	1.0	+0.7	-6.4	+0.3
Lakehurst, N. J. ¹ (39 m)	25	5.6	0.0	5.8	+0.4	3.6	+0.3	1.9	+0.5	-0.7	0.0	-2.8	+0.1	-4.6	+0.4	-10.1	-0.1	-15.8	-0.4
Maxwell Field (Montgomery), Ala. ¹ (52 m)	28	14.8	-0.3	15.0	-0.8	12.1	-1.2	9.9	-0.8	7.8	-0.5	5.5	-0.3	3.4	+0.2	-2.2	+0.4	-9.1	0.0
Miami, Fla. ¹ (4 m)	30	18.8	-----	19.5	-----	16.2	-----	13.5	-----	11.3	-----	9.7	-----	7.3	-----	1.8	-----	-3.8	-----
Mitchel Field (Hempstead, L. I.), N. Y. ¹ (29 m)	26	4.9	-0.5	7.0	+0.9	5.2	+1.1	3.2	+1.3	1.1	+1.2	-1.0	+1.4	-3.3	+1.1	-9.3	+0.6	-----	-----
Murfreesboro, Tenn. ¹ (174 m)	30	10.5	+0.4	12.0	+0.4	9.8	0.0	7.2	-0.4	4.4	-0.8	2.1	-0.8	-0.7	-1.0	-6.4	-1.0	-12.8	-1.0
Norfolk, Va. ¹ (10 m)	19	9.0	-2.2	8.8	-2.1	6.9	-1.9	4.3	-2.1	1.9	-2.1	-0.2	-1.8	-2.6	-1.5	-8.4	+0.3	-14.9	-0.4
Oakland, Calif. ¹ (2 m)	30	10.1	-----	9.8	-----	9.1	-----	7.0	-----	4.5	-----	2.0	-----	-1.0	-----	-7.1	-----	-13.3	-----
Oklahoma City, Okla. ¹ (391 m)	29	11.4	0.0	12.9	+0.3	13.9	+1.4	12.4	+1.0	10.5	+1.0	7.4	+1.0	4.1	+1.2	-3.4	+1.1	-11.6	+0.6
Omaha, Nebr. ¹ (300 m)	30	6.9	+0.2	7.2	-0.1	5.9	-0.9	4.4	-0.6	2.3	-0.5	-0.2	-0.6	-2.8	-0.4	-8.8	-0.1	-15.6	+0.1
Pensacola, Fla. ¹ (13 m)	27	15.5	-2.1	15.9	-0.5	13.4	-1.1	11.3	-1.2	9.3	-1.0	7.8	+0.1	5.1	+0.1	-0.4	+0.9	-6.5	+1.3
St. Thomas, Virgin Islands ¹ (8 m)	26	23.8	-----	21.3	-----	18.5	-----	15.1	-----	12.5	-----	11.1	-----	9.3	-----	5.2	-----	-0.2	-----
Salt Lake City, Utah ¹ (1,288 m)	30	4.5	-----	-----	-----	-----	-----	6.9	-----	4.1	-----	0.7	-----	-2.9	-----	-8.8	-----	-14.3	-----
San Diego, Calif. ¹ (10 m)	28	12.2	-3.0	12.6	-0.6	12.4	0.0	11.0	+0.1	8.8	-0.2	6.4	+0.2	4.3	+0.8	-0.4	+1.4	-7.6	+1.1
Sault Ste. Marie, Mich. ¹ (221 m)	28	1.4	-----	1.8	-----	0.0	-----	-1.6	-----	-3.1	-----	-4.9	-----	-7.3	-----	-13.0	-----	-19.1	-----
Scott Field (Belleville), Ill. ¹ (135 m)	22	7.4	+0.7	9.7	+0.2	8.5	+0.5	6.4	+0.5	3.5	-0.2	0.4	-0.7	-2.1	-0.8	-8.0	-1.0	-15.1	-1.2
Seattle, Wash. ¹ (10 m)	5	11.5	-----	7.3	-----	3.3	-----	0.2	-----	-2.6	-----	-4.7	-----	-6.9	-----	-12.8	-----	-18.2	-----
Selridge Field (Mount Clemens), Mich. ¹ (177 m)	28	4.1	-----	5.4	-----	4.6	-----	2.4	-----	0.0	-----	-2.0	-----	-4.4	-----	-9.6	-----	-15.8	-----
Spokane, Wash. ¹ (596 m)	30	5.0	-0.5	-----	-----	6.1	-0.1	3.9	-0.6	0.2	-1.0	-3.5	-1.3	-7.0	-1.5	-13.0	-1.5	-19.2	-1.0
Washington, D. C. ¹ (13 m)	22	7.7	-2.1	8.4	0.0	5.5	-0.6	3.3	-0.5	1.3	-0.4	-0.2	-0.1	-2.7	-0.5	-8.4	-0.9	-14.6	-1.4
Wright Field (Dayton), Ohio ¹ (244 m)	28	6.4	+0.6	8.2	+0.9	6.7	+0.8	4.7	+0.8	2.4	+0.6	-0.5	+0.1	-3.0	-0.1	-8.5	-0.3	-15.7	-1.1

¹ Army.² Weather Bureau.³ Navy.

Observations taken about 4 a. m., 75th meridian time, except by Navy stations along the Pacific coast and Hawaii where they are taken at dawn.

NOTE.—The departures are based on normals covering the following total number of observations made during the same month in previous years, including the current month (years of record are given in parentheses following the number of observations): Billings, 89 (3); Boston, 96 (4); Cheyenne, 88 (3); Fargo, 88 (3); Kelly Field, 84 (3); Lakehurst, 72 (3); Maxwell Field, 75 (3); Mitchel Field, 74 (3); Murfreesboro, 90 (3); Norfolk, 149 (8); Oklahoma City, 88 (3); Omaha, 179 (6); Pensacola, 205 (9); San Diego, 190 (8); Scott Field, 69 (3); Spokane, 90 (3); Washington, 229 (11); Wright Field, 80 (3).

TABLE 2.—Mean free-air relative humidities (R. H.), in percent, and specific humidities (q), in grams/kilogram, obtained by airplanes during April 1937 (Dep. represents departure from "normal" relative humidity)

Station	Altitude (meters) m. s. l.																															
	Number of observations	Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000														
		q	R. H.		R. H.		R. H.		R. H.		R. H.		R. H.		R. H.		R. H.		R. H.													
			Mean	Dep.	Mean	Dep.	Mean	Dep.	Mean	Dep.	Mean	Dep.	Mean	Dep.	Mean	Dep.	Mean	Dep.	Mean	Dep.												
Barksdale Field, La.	29	7.9	78	---	7.2	68	---	6.1	59	---	5.1	51	---	3.7	41	---	3.0	37	---	2.3	33	---	1.6	31	---	0.9	55	---	0.0	55	---	-2
Billings, Mont.	30	3.6	62	-1.6	---	---	---	---	---	---	3.5	51	-1.6	3.1	51	-1.5	2.8	57	-1.3	2.4	61	-1.2	1.7	66	-1.2	0.9	66	-1.2	0.9	66	-1.2	0.9
Boston, Mass.	25	3.9	71	+1	3.6	67	0	3.3	66	+2	3.0	67	+5	2.8	63	+1	2.2	58	-1.3	1.9	54	-1.4	1.5	55	+1	1.0	55	+1	1.0	55	+1	1.0
Cheyenne, Wyo.	30	3.6	72	+1	---	---	---	---	---	---	---	---	---	3.6	66	0	3.0	60	+1	2.3	58	0	1.6	58	+1	1.0	58	+1	1.0	58	+1	1.0
Coco Solo, Canal Zone.	30	17.7	85	---	17.1	89	---	15.5	88	---	13.6	84	---	11.2	74	---	8.8	61	---	7.1	54	---	4.7	46	---	3.5	44	---	3.5	44	---	3.5
El Paso, Tex.	30	2.6	25	---	---	---	---	---	---	---	2.7	20	---	2.2	19	---	1.8	18	---	1.5	19	---	1.1	20	---	0.8	20	---	0.8	20	---	0.8
Fargo, N. Dak.	28	4.1	84	+1	4.0	76	+3	3.6	74	+6	3.1	71	+6	2.7	69	+5	2.3	67	+6	1.9	63	+4	1.4	60	+4	1.0	62	+4	1.0	62	+4	1.0
Kelly Field, Tex.	26	8.0	79	-3	8.7	71	-4	7.0	56	-6	5.7	47	-4	4.6	39	-2	3.7	34	-3	3.1	32	-3	2.2	33	-2	1.7	37	-2	1.7	37	-2	1.7
Lakehurst, N. J.	25	4.3	76	-2	4.1	67	0	3.7	66	+1	3.4	63	-2	3.1	68	+1	2.9	68	+3	2.5	62	+3	1.7	60	+6	1.2	61	+12	1.2	61	+12	1.2
Maxwell Field, Ala.	28	7.9	75	-2	6.3	56	-4	5.3	55	-3	4.2	47	-7	3.5	41	-9	3.0	39	-7	2.4	35	-7	1.6	32	-2	1.0	30	-1	1.0	30	-1	1.0
Miami, Fla.	30	11.9	89	---	11.3	76	---	9.6	75	---	7.8	69	---	6.5	62	---	4.9	49	---	3.8	42	---	2.7	39	---	2.0	37	---	2.0	37	---	2.0
Mitchel Field, N. Y.	26	4.2	79	+2	4.8	73	+4	4.4	71	+5	3.9	67	+2	3.7	69	+3	3.3	70	+6	2.9	65	+4	1.8	62	+4	1.0	62	+4	1.0	62	+4	1.0
Murfreesboro, Tenn.	30	6.3	79	-3	5.8	63	-8	5.4	55	-5	4.7	63	-4	4.0	61	-5	3.5	59	-3	2.8	55	+3	1.6	43	-6	1.0	42	-4	1.0	42	-4	1.0
Norfolk, Va.	19	5.0	71	+1	4.4	57	-1	3.9	55	-1	3.6	59	+4	3.3	58	+4	2.7	53	+1	2.1	49	-2	1.3	43	-6	0.8	41	-3	0.8	41	-3	0.8
Oakland, Calif.	30	6.3	83	---	5.5	70	---	4.3	54	---	3.5	48	---	2.8	40	---	1.9	33	---	1.7	33	---	1.2	33	---	0.9	34	---	0.9	34	---	0.9
Oklahoma City, Okla.	29	6.8	77	+9	6.8	69	+4	6.0	55	-1	5.0	47	0	4.1	41	1	3.6	41	0	2.9	39	-3	1.8	38	-4	1.0	41	+1	1.0	41	+1	1.0
Omaha, Nebr.	30	5.2	81	+10	5.2	78	+10	4.9	75	+12	4.3	68	+9	3.6	63	+7	3.0	59	+5	2.5	57	+4	1.9	56	+3	1.0	52	0	1.0	52	0	1.0
Pensacola, Fla.	27	9.4	86	+6	8.4	71	+1	6.8	63	0	5.3	53	-3	4.2	45	-5	2.8	32	-14	2.1	26	-18	1.4	24	-18	0.8	21	-16	0.8	21	-16	0.8
St. Thomas, Virgin Islands.	26	15.7	85	---	14.7	88	---	12.8	87	---	10.8	85	---	9.0	79	---	6.8	61	---	4.9	47	---	2.4	27	---	1.1	19	---	1.1	19	---	1.1
Salt Lake City, Utah.	30	4.0	67	---	---	---	---	---	---	---	4.4	60	---	3.8	59	---	3.3	61	---	2.9	60	---	2.1	67	---	1.5	63	---	1.5	63	---	1.5
San Diego, Calif.	28	7.3	83	+9	7.1	75	0	6.0	60	-1	4.7	48	-1	3.9	42	+3	3.1	39	+5	2.6	36	+7	1.8	31	+8	1.1	30	+8	1.1	30	+8	1.1
Sault Ste. Marie, Mich.	28	3.6	83	---	3.6	77	---	3.2	76	---	3.0	74	---	2.6	66	---	2.2	61	---	2.0	59	---	1.1	50	---	0.7	47	---	0.7	47	---	0.7
Scott Field, Ill.	22	5.0	78	-1	4.7	58	+1	4.0	51	-2	3.4	47	-3	2.7	46	-3	2.4	46	-2	2.0	42	-5	1.3	39	-5	0.9	42	-1	0.9	42	-1	0.9
Seattle, Wash.	5	5.0	61	---	4.1	63	---	3.4	64	---	2.8	62	---	2.3	60	---	1.9	56	---	1.7	54	---	1.2	55	---	1.0	58	---	1.0	58	---	1.0
Selridge Field, Mich.	28	4.2	82	---	4.3	72	---	3.9	66	---	3.4	63	---	3.0	60	---	2.6	58	---	2.2	55	---	1.5	49	---	1.0	48	---	1.0	48	---	1.0
Spokane, Wash.	30	4.6	79	+6	---	---	---	---	---	---	4.4	67	+3	3.8	65	+4	3.4	70	+6	2.9	74	+7	1.6	76	+9	1.9	77	+14	1.9	77	+14	1.9
Washington, D. C.	22	4.8	73	+7	4.4	61	+1	4.0	63	+4	3.5	59	+2	3.2	61	+5	2.7	53	0	2.2	48	-2	1.4	41	-6	0.9	34	+10	0.9	34	+10	0.9
Wright Field, Ohio.	28	5.0	81	+1	4.8	66	-5	4.5	65	-3	4.0	63	-3	3.4	59	-5	2.9	57	-5	2.4	54	-5	1.4	43	-9	0.9	44	-5	0.9	44	-5	0.9

TABLE 3.—Mean free-air barometric pressures (*P*), in mb, and equivalent potential temperatures (θ_e), in °A. obtained by airplanes during April 1937

Stations	Altitude (meters) m. s. l.																		
	Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000		
	Number of observations	P	θ_s	P	θ_s	P	θ_s	P	θ_s	P	θ_s	P	θ_s	P	θ_s	P	θ_s	P	θ_s
Barksdale Field, La.	29	1,008	309	955	311	900	312	848	313	799	312	751	313	707	314	624	315		
Billings, Mont.	30	888	298					845	303	795	304	746	305	701	305	616	306	541	307
Boston, Mass.	25	1,017	288	957	291	900	293	846	295	794	299	745	300	699	302	613	307		
Cheyenne, Wyo.	30	808	302							795	304	746	306	701	306	616	306	541	307
Coco Solo, Canal Zone.	30	1,009	348	952	350	899	349	849	348	800	343	754	340	711	338	630	336	559	337
El Paso, Tex.	30	879	305					847	312	798	312	752	312	708	312	626	314	551	311
Fargo, N. Dak.	28	980	289	954	292	898	294	842	295	791	297	742	299	696	300	610	304	635	308
Kelly Field, Tex.	26	991	310	958	318	904	318	852	318	803	319	756	319	712	320	631	320	557	320
Lakehurst, N. J.	28	1,012	290	956	294	899	296	846	299	795	300	746	303	701	305	616	308	541	311
Maxwell Field, Ala.	28	1,006	309	958	309	902	309	850	309	800	310	753	312	708	313	625	315	551	311
Miami, Fla.	30	1,016	323	959	328	905	325	853	323	804	323	757	321	712	322	630	323	556	326
Mitchel Field, N. Y.	26	1,014	289	957	297	900	300	846	301	796	304	747	306	702	308	627	307		
Murfreesboro, Tenn.	30	994	302	955	305	900	307	847	308	798	308	750	310	704	310	621	311	546	313
Norfolk, Va.	19	1,016	295	958	298	902	300	849	301	798	304	750	304	704	305	620	308	546	310
Oakland, Calif.	30	1,019	299	960	302	903	303	850	304	800	305	752	305	707	306	622	309	547	312
Oklahoma City, Okla.	29	965	306	953	309	898	314	846	315	797	316	750	316	706	315	623	315	550	314
Omaha, Nebr.	30	976	296	952	299	896	302	842	304	792	305	744	306	700	307	615	310	541	311
Pensacola, Fla.	27	1,016	313	960	316	905	314	852	313	802	314	754	313	710	313	627	317	553	319
St. Thomas, Virgin Islands.	26	1,016	339	961	339	907	337	855	333	806	330	758	328	714	326	632	326	560	326
Salt Lake City, Utah.	30	870	300					849	306	799	307	750	307	705	308	621	310	546	313
San Diego, Calif.	28	1,014	304	956	309	901	311	849	312	799	313	752	313	707	315	625	318	551	319
Sault Ste. Marie, Mich.	28	988	285	955	289	897	291	842	294	790	297	742	299	696	301	611	303	536	306
Scott Field, Ill.	22	999	294	957	300	901	302	848	303	798	304	749	305	704	306	620	308	545	310
Seattle, Wash.	5	1,019	297	960	295	902	295	849	295	798	296	749	297	702	300	617	303	540	307
Selfridge Field, Mich.	28	993	289	954	294	898	297	845	299	795	300	746	303	701	305	617	308	542	310
Spokane, Wash.	30	944	296			899	301	845	302	795	302	746	302	704	302	615	305	539	297
Washington, D. C.	22	1,017	293	958	297	901	299	848	300	796	303	749	305	704	306	619	308	544	312
Wright Field, Ohio.	28	985	295	954	298	898	301	845	303	795	304	746	306	702	307	618	308	543	310

TABLE 4.—Free-air resultant winds (meters per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during April 1937

(Wind from N=360°, E=90°, etc.)

Altitude (meters) m. s. l.	Albuquerque, N. Mex. (1,554 m)		Atlanta, Ga. (309 m)		Billings, Mont. (1,088 m)		Boston, Mass. (15 m)		Cheyenne, Wyo. (1,873 m)		Chicago, Ill. (192 m)		Cincinnati, Ohio (153 m)		Detroit, Mich. (204 m)		Fargo, N. Dak. (274 m)		Houston, Tex. (21 m)		Key West, Fla. (11 m)		Medford, Oreg. (410 m)		Murfreesboro, Tenn. (180 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	308	2.3	279	1.4	274	2.3	343	1.4	277	2.9	130	0.5	270	0.3	188	0.3	26	2.0	156	0.4	101	2.1	320	0.8	194	1.8
500	—	—	270	4.4	—	—	359	3.5	—	—	202	2.9	211	3.5	196	0.8	68	0.9	189	4.2	120	4.2	312	1.1	204	4.6
1,000	—	—	263	5.5	—	—	338	4.3	—	—	232	5.5	239	7.1	261	2.4	247	0.9	200	5.0	150	3.0	247	1.2	235	5.1
1,500	—	—	265	7.1	276	4.3	316	3.8	—	—	242	5.5	257	8.5	268	6.0	283	3.7	258	3.8	186	3.1	216	2.7	252	7.7
2,000	284	9.9	267	9.3	282	4.3	330	5.8	274	5.0	245	5.5	260	6.8	296	7.1	332	2.8	283	6.0	229	3.3	224	5.3	272	8.9
2,500	290	9.0	272	9.3	287	4.9	323	6.1	275	8.3	302	5.4	268	6.1	297	8.1	337	5.0	298	9.4	272	2.3	260	4.7	286	9.6
3,000	280	7.8	278	9.5	289	6.2	344	7.0	289	9.8	—	—	288	7.5	303	8.8	309	9.1	276	6.8	297	3.3	259	4.7	295	9.2
4,000	269	10.1	—	—	284	6.8	—	—	289	11.4	—	—	—	—	—	—	—	—	292	4.6	—	—	297	10.3	—	—
5,000	282	9.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Altitude (meters) m. s. l.	Newark, N. J. (14 m)		Oakland, Calif. (8 m)		Oklahoma City, Okla. (402 m)		Omaha, Nebr. (306 m)		Pearl Harbor, Territory of Hawaii ¹ (68 m)		Pensa- cola, Fla. ¹ (24 m)		St. Louis, Mo. (170 m)		Salt Lake City, Utah (1,294 m)		San Diego, Calif. (15 m)		Sault Ste. Marie, Mich. (198 m)		Seattle, Wash. (14 m)		Spokane, Wash. (603 m)		Washing- ton, D. C. (10 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	342	1.2	295	1.0	175	1.8	81	0.3	64	3.4	307	1.0	202	1.4	148	1.8	107	0.8	90	1.8	175	2.6	177	1.6	305	0.6
500	344	3.5	307	3.5	166	3.6	205	1.5	72	7.0	250	3.1	211	4.1	—	—	348	0.8	98	4.0	197	5.7	—	—	295	2.5
1,000	319	2.1	324	4.2	227	8.1	258	5.2	81	6.2	284	3.7	241	6.5	—	—	345	2.2	121	3.7	192	6.6	208	4.1	292	7.3
1,500	294	4.0	312	4.5	256	7.8	259	7.8	89	4.9	287	5.0	269	7.4	144	1.6	344	2.3	100	0.8	202	5.9	229	5.2	285	9.7
2,000	305	6.1	309	4.8	263	8.3	274	9.1	100	3.9	298	5.1	279	6.2	221	0.6	11	1.5	332	1.4	215	3.9	241	5.7	299	10.6
2,500	312	10.5	306	5.1	277	9.1	302	8.6	101	2.6	326	4.5	286	6.8	237	3.0	353	2.0	346	2.2	234	6.6	226	5.3	287	10.2
3,000	307	10.3	306	5.3	281	7.2	299	9.9	101	2.2	308	5.3	281	8.2	259	4.6	314	4.2	6	4.7	—	—	233	3.8	289	13.2
4,000	—	—	—	—	—	—	—	—	336	0.8	—	—	—	—	259	7.4	290	6.0	—	—	—	—	—	—	—	—
5,000	—	—	—	—	—	—	—	—	—	—	—	—	—	294	10.6	—	—	—	—	—	—	—	—	—	—	—

¹ Navy stations.

TABLE 5.—Maximum free-air wind velocities (M. P. S.), for different sections of the United States based on pilot-balloon observations during April 1937

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum velocity	Direction	Altitude (m) M. S. L.	Date	Station	Maximum velocity	Direction	Altitude (m) M. S. L.	Date	Station	Maximum velocity	Direction	Altitude (m) M. S. L.	Date	Station
Northeast ¹	30.5	W	1,190	18	Pittsburgh	36.4	WNW	4,450	20	Buffalo	42.4	N	8,490	12	Albany.
East-Central ²	33.7	WSW	1,500	14	Cincinnati	41.2	N	5,000	16	Greensboro	42.5	N	5,220	16	Greensboro.
Southeast ³	31.5	SW	2,084	5	Jacksonville	38.0	WSW	4,539	25	Atlanta	36.5	WNW	7,664	12	Jacksonville.
North-Central ⁴	34.7	W	1,370	13	Detroit	32.0	WNW	5,000	19	Detroit	35.4	WNW	5,336	19	Detroit.
Central ⁵	41.0	SW	1,230	17	Wichita	30.5	WNW	2,622	13	Chicago	30.0	NW	5,740	1	Wichita.
South-Central ⁶	37.2	SSW	1,527	6	Ablene	36.4	W	5,000	24	Dallas	37.2	W	5,100	24	Dallas.
Northwest ⁷	27.4	SSW	1,374	4	Portland	34.6	SSW	5,000	25	Medford	35.0	SSW	5,180	25	Medford.
West-Central ⁸	36.2	W	2,470	6	Modena	51.0	WSW	4,856	15	Reno	51.2	WNW	6,970	6	Modena.
Southwest ⁹	51.3	SW	2,290	22	Winslow	43.2	NW	4,705	3	Fresno	46.8	W	8,130	25	El Paso.

¹ Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and northern Ohio.² Delaware, Maryland, Virginia, West Virginia, southern Ohio, Kentucky, eastern Tennessee, and North Carolina.³ South Carolina, Georgia, Florida, and Alabama.⁴ Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.⁵ Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.⁶ Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and western Tennessee.⁷ Montana, Idaho, Washington, and Oregon.⁸ Wyoming, Colorado, Utah, northern Nevada, and northern California.⁹ Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.

LATE REPORTS

TABLE 1.—Mean free-air temperatures (*t*), °C obtained by airplanes during March 1937. (Dep. represents departure from "normal" temperature.)

Station	Altitude (meters) m. s. l.																		
	Surface			500		1,000		1,500		2,000		2,500		3,000		4,000		5,000	
	Number of observations	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.
Pearl Harbor, T. H. ¹ (6 m)-----	31	19.9	-2.1	18.1	-1.6	15.1	-1.1	12.4	-0.8	10.3	-0.7	9.4	-0.2	7.4	-0.1	2.3	0.0	-3.7	-1.4

¹ Navy; observations taken at dawn.

NOTE.—The departures are based on normals covering the following total number of observations made during the same month in previous years, including the current month years of record are given in parenthesis following the number of observations): Pearl Harbor, 143 (6).

TABLE 2.—Mean free-air relative humidities (R. H.), in percent, and specific humidities (*q*), in grams/kilogram, obtained by airplanes during March 1937 (Dep. represents departure from "normal" relative humidity.)

Station	Altitude (meters) m. s. l.																																				
	Surface				500				1,000				1,500				2,000				2,500				3,000				4,000				5,000				
	Number of observations	q			R. H.			q			R. H.			q			R. H.			q			R. H.			q			R. H.			q			R. H.		
		q	Mean	Dep.	q	Mean	Dep.	q	Mean	Dep.	q	Mean	Dep.	q	Mean	Dep.	q	Mean	Dep.	q	Mean	Dep.	q	Mean	Dep.	q	Mean	Dep.	q	Mean	Dep.						
Pearl Harbor, T. H.	31	11.8	83	+9	11.1	82	+6	10.3	87	+8	8.7	83	+7	7.1	73	+5	4.9	50	-2	3.7	40	-1	2.2	31	+2	1.5	28	+1									

TABLE 3.—Mean free-air barometric pressures (*P*), in mb, and equivalent potential temperatures (Θ_E), in °A obtained by airplanes during March 1937

Station	Altitude (meters) m. s. l.																		
	Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000		
	Number of observations	P	Θ_s	P	Θ_s	P	Θ_s	P	Θ_s	P	Θ_s	P	Θ_s	P	Θ_s	P	Θ_s		
Pearl Harbor, T. H.....	31	1,015	324	959	326	904	326	852	324	803	323	755	321	711	321	628	322	554	324